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## A Free-Floating Right Atrial Thrombus: Playing a Squash Match with Badminton Equipment. An Old Problem Managed by a New Technique

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A large, unattached right atrial thrombus was accidentally detected in a 29 year old man with pneumonia and history of surgically corrected congenital heart disease. As surgery was not feasible, improvised management is described consisting of a combination of catheter-based extraction and mechanical fragmentation with local thrombolysis requiring temporary right atrial filter insertion. This was accomplished using a newly developed multipurpose wire-mesh basket resembling a badminton shuttle-cock. The above procedure was successful: the thrombus problem was solved within 24 hours. The procedure was steered by echocardiography and fluoroscopy. *J Clin Basic Cardiol 2002; 5: 115–117.*

**Key words:** intra-atrial thrombus, atrial filter, fragmentation, extraction, thrombolysis

We present the case of a 29 year old man, who underwent surgical correction of his congenital heart disease at the age of 14: pulmonary artery stenosis, severe tricuspid regurgitation and severe right atrial dilation. The surgical procedure included pulmonary artery valvulotomy, right atrial plication, and tricuspid valvuloplasty. After the procedure, the right atrium remained enlarged, there was mild tricuspid regurgitation and trace mitral regurgitation. The patient had no medical follow-up. About 2 weeks prior to admission, he noted high temperature and cough with expectoration of green-yellow sputum. Dyspnoea gradually worsened. Several days prior to admission, he noticed leg oedema. On physical exam the patient was dyspnoeic, febrile, in atrial fibrillation with a ventricular rate of 140/min. Chest auscultation was suggestive of right lower lobe pneumonia. He had signs of right-heart failure (enlarged neck veins with signs of elevated pressure, hepatomegaly and bilateral, below the knee oedema).

Abnormal laboratory results included leukocytosis ( $18.8 \times 10^9/L$ ) and prothrombin time of 66 % (INR 1.3). Chest X-ray confirmed right lower lobe infiltrate. Lung scan excluded pulmonary embolism. Transthoracic echocardiogram revealed normal left-ventricular size and function and normal left atrial size. The dominant finding was a gigantic right atrium ( $78 \times 89$  mm), dilated right ventricle (36 mm in diameter), with significant tricuspid regurgitation. The pulmonary artery trunk was 39 mm in diameter, while its branches at bifurcation were 25 mm. A round mass was detected in the right atrium. Transoesophageal echocardiography confirmed an unattached, homogenous right atrial mass of 25 mm diameter. The motion of the mass resembled the movement of a squash ball: bouncing back off all walls, occasionally even from the tricuspid valve. The presence of spontaneous echocardiography contrast in the right atrium suggested potential for further growth. The thrombus resembled the sword of Damocles with real risk of massive pulmonary embolism. Presence of pneumonia increased the risk of surgical procedure (atrial thrombectomy).

Intravenous heparin (at a dose of 1,000 IU/hr) and i. v. antibiotics were started. While intravenous thrombolysis was initially contemplated, we decided to handle the thrombus

instrumentally: We wished to use catheter-based fixation of the mobile thrombus in the atrium and use thrombolysis after mechanical fragmentation of the thrombus.

### Catheterization

For sedation we used a combination of fentanyl and midazolam (Dormicum, F. Hoffman-La Roche, Ltd., Switzerland). A transoesophageal echo probe was inserted and a 13F 50-cm sheath with a haemostatic valve was advanced via the right femoral vein. The end of the sheath was placed at the origin of the inferior vena cava in the right atrium. Mean right atrial pressure was 10 mmHg. Next, we inserted a special basket fixed by wire to a transeptal needle. The basket was made from 0.3 mm stainless steel wire: The wire was bent to resemble the letter 'V' with both arms first connected at a distance of 50 mm from the bend; the joints of the wires were welded, and another link was made using a fixation tube made from titanium (10 mm long, outer diameter 4 mm). Overall, there were 16 such 'eyes'. The eyes were connected one to the other again by welding at a distance of 25 mm from the top of the wire bend (ie, from the unfixed section). The result resembles wire mesh, when seen from the side, a badminton shuttle-cock with three conical stages in the shape of the letter 'Z' with each side 25 mm long, making the basket self-expandable. When expanded, the opening measures 65 mm in diameter. Compressed, the basket can be inserted with a sheath as small as 11F (Fig. 1G, 1H).

Under fluoroscopic control, using a mobile device (Siremobil 2000, Siemens, Germany), we advanced the sheath up to the distal third of the right atrium, moving the compressed basket about 1.5 cm from the sheath's edge. A small amount of agitated saline was injected into the sheath to provide for basic orientation in the ultrasound image. After several attempts of pushing (and retracting) the basket from the sheath into the right atrium, we succeeded in grasping the thrombus. Its immobilization was clearly visible on the echocardiogram. Still, after a few minutes, the thrombus escaped from the basket and the procedure had to be repeated. This time we closed the basket in the position and tried to fragment the thrombus. Using the sheath, we removed a total

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of 7 fragments of which 3 were sent to histology. The echocardiogram showed a smaller size of the thrombus. The thrombus volume – approximated to a ball 25 mm in diameter – was calculated to be approximately 8.2 cm<sup>3</sup>. A pathologist reported the size of the three extracted samples to be 15 × 6 × 4 mm, 15 × 5 × 3 mm, and 4 × 4 × 2 mm, respectively. Our estimate was that, including fragments not sent in for histology, a total of about 1.5 cm<sup>3</sup> had been extracted (almost a fifth of the total thrombus volume). The evidence of thrombus unweaving served as a signal for us to start thrombolysis. The basket was positioned so as to block entry into the tricuspid orifice as an analogy to a vena cava filter. Next, alteplase (Actilyse, Boehringer Ingelheim, Germany) was administered directly via the sheath to the right atrium. The administration was started with a bolus of 20 mg and a total of additional 140 mg were infused over 20 hours. After administration of this dose of alteplase, echocardiography was repeated and demonstrated no intracardiac mass. Right-heart catheterization was done: mean right atrial pressure was 10 mmHg, right ventricular systolic/end-diastolic pressure was 34/3 mmHg, mean pulmonary artery pressure was 20 mmHg, and mean pulmonary artery wedge pressure was 11 mmHg. These values suggested that no pulmonary embolism had occurred.

The procedure, as shown by echocardiography, is presented in Figure 1 (Fig. 1A–F). Histological results confirmed a fresh thrombus without signs of organization. (Fig. 2).

The ensuing course was uneventful. The patient was treated with heparin for another 4 days and then switched to warfarin. Follow-up chest X-ray 11 days later showed resolution of the lung infiltrate.

Discussion

Intracardiac thrombosis has been extensively studied especially in left-heart chambers, mainly because of the possibility of fatal embolism. No matter whether valve disease has been demonstrated or not, the key factor for thrombus formation is excessive size of heart chambers (atria in particular), the presence of atrial fibrillation, and the finding of spontaneous echocontrast representing the pre-thrombotic stage [1–7]. Of course, the same pathophysiological principles apply to right-heart chambers. The role of right-heart thrombi is unjustly given less attention. Undoubtedly, the basic diagnostic tool is echocardiography, transoesophageal echocardiography in particular. Isotopic methods may be less important, while biopsy can be considered for a more exact diagnosis [8]. Most

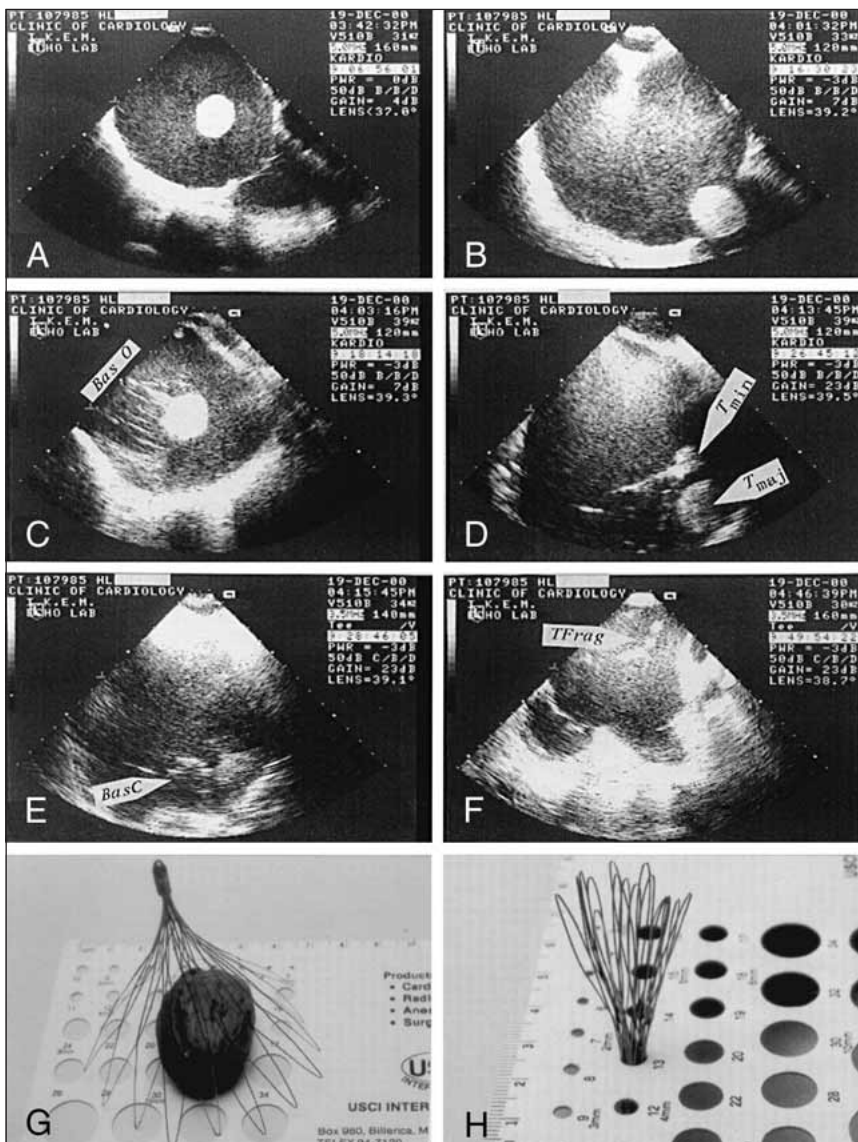


Figure 1.

- A Thrombus as a squash ball in the central part of the right atrium
  - B At the level of the tricuspid orifice
  - C Thrombus grasped by the basket
  - D Thrombus squeezed against the atrial wall, breaking up into a smaller part (Tmin) and a bigger part (Tmaj)
  - E Thrombus compression
  - F Final appearance of thrombus after fragmentation prior to thrombolysis
  - G Basket resembling a shuttle-cock: open position (the walnut inside is 25 mm in diameter, mimicking the thrombus as described above); see also Fig.1C
  - H Compressed position in an opening equal to 13F
- BasO= basket opened  
 BasC= basket compressed  
 Tmin = smaller fragment of the thrombus  
 Tmaj= bigger fragment  
 Tfrag= thrombus fragmentation

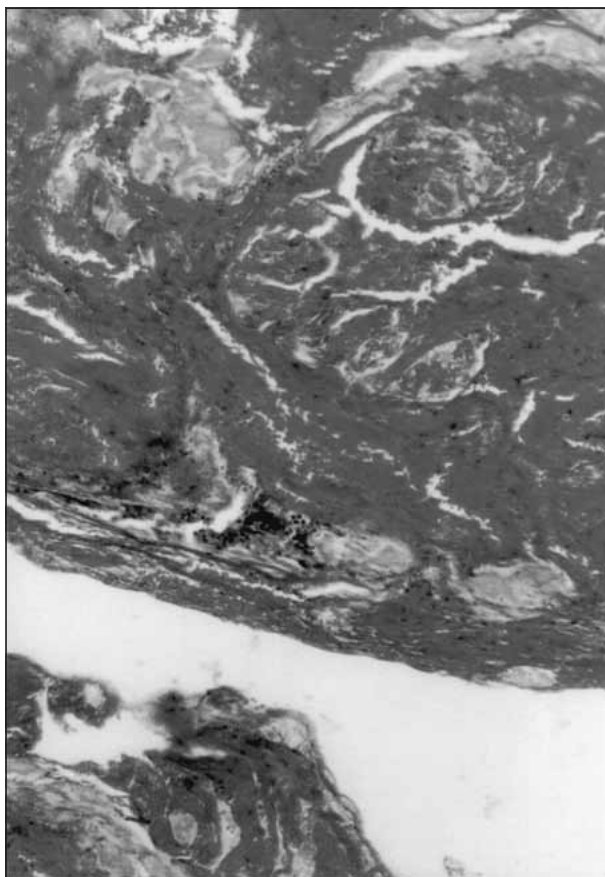


Figure 2. A typical fresh thrombus

often, a right atrium thrombus is found in connection with previous pulmonary embolism [9, 10]. Otherwise, the finding may be accidental during routine echocardiography or, in rare cases, eg, in connection with paradoxical embolism [11]. Thrombus management depends on the patient's clinical status: while, with fixed thrombi, conventional anticoagulant therapy is usual, mobile thrombi are managed surgically or with thrombolytics [12–14].

In our case, the finding was accidental, however, there were signs of an emergent risk. Moreover, the problem was modulated by present pneumonia increasing the risk of considered cardiac surgery. Therefore, we opted for a combined mechanical and pharmacological approach. The following

are individual steps and the rationales along with our subjective evaluation: (a) thrombus immobilization in the right atrium (partially successful: the problem was the size of the instrumentarium and right atrial size); (b) reduction of thrombus volume by partial extraction along with the possibility to obtain a sample for histological analysis (successful); (c) fragmentation and change in the configuration in an effort to increase the surface area and increase the speed of thrombolysis (successful); (d) mechanical blockage, using the basket as a temporary filter, of potential thrombus passage beyond the tricuspid orifice (successful) and (e), after taking the above mechanical measures, institution of thrombolysis (successful).

The technique described above was successful, pulmonary embolism was avoided. We believe, improvement of the method will allow its use in future patients.

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